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CLAIMS

1. A press brake wherein upper table provided with an upper tool holder and a lower table provided with a lower tool holder is opposed to each other upwards and downwards and either the upper table or the lower table is made free to be moved up and down, characterized in that on the rear side of the upper table, an exchange upper tool support that supports a plurality of divided upper tools free to mount and demount is provided, and an upper tool exchange device to exchange divided upper tools between the exchange upper tool support and upper table is provided, and on the rear side of the lower table, an exchange lower tool support that supports a plurality of divided lower tools free to mount and demount is provided, and a lower tool exchange device to exchange divided lower tools between the exchange lower tool support and the lower table is provided.

2. The press brake according to claim 1, wherein upper and lower exchange tool supports is provided free to move up and down, and upper and lower exchange tools supports is provided free to move in the left and right directions respectively, and wherein the upper and lower divided tools may be freely supported respectively by the tool holders provided free to move up and down on the upper and lower tool exchange devices.

3. A press brake wherein upper table provided with an upper tool holder and a lower table provided with a lower tool holder is opposed to each other upwards and downwards and either the upper table or the lower table is made free to be moved up and down, characterized in that a left-right directed upper guide part provided on the back of the upper table is formed such that it protrudes largely in the left and right directions from the sides

of the upper table, and the exchange upper tool support that support free to attach or detach a plurality of divided upper tools to be mounted and demounted and exchanged to the upper table is provided free to be positioned on the section protruded sideways from the upper guide, and an upper tool exchange device to exchange divided upper tools between this exchange upper tool support and the upper table is provided free to move in the left-right directions on the upper guide, and the left-right directed lower guide provided in the rear side of the lower table is provided protruding largely in the left-right directions from the sides of the lower table, and an exchange lower tool support that supports free to attach or detach a plurality of divided lower tools to be attached and exchanged to the lower table is provided free to be positioned on a section protruded sideways from the lower guide, and a lower tool exchange device to exchange divided lower tools between this exchange lower tool support and the lower table, is provided free to move in the left-right directions on the lower guide.

4. The press brake as described in claim 3, characterized in that on the backward position of the protruded part of the upper guide, provision of an upper tool housing section that houses a plurality of exchange upper tool supports that support a plurality of divided upper tools free to attach or detach is made, and provision of a tool support exchange device free to move back and forth in order to exchange upper tool supports between this upper tool housing section and the protruded part of the upper guide.

5. The press brake as described in claim 4, characterized by provision in the tool support exchange device of a rotation section to reverse the front and

rear of the exchange upper tool support.

5 6. The press brake as described in claim 3, 4 or 5,
characterized in that a lower tool housing section, which
houses a plurality of exchange lower tool supports which
support a plurality of divided lower tools free to attach
and detach, is provided on the lower position of the
part protruding from the sides of the lower guide, and
together with providing the lower tool housing section
10 free to move forward and backwards, an exchange lower
tool support elevator is provided that moves upwards
the exchange lower tool support positioned at a position
below the part protruded from the sides of the lower
guide up to the position of the protruded part.

15 7. The press brake as described in any one of claim
1-6, characterized in that a bending robot that holds
the work and freely supplies it between the upper and
lower tools and a temporary holding device that holds
20 the work temporarily are provided.

25 8. A divided tool that is freely mounted and demounted
and exchanged to a tool holder of a press brake,
characterized in that a shank part that is engaged or
disengaged freely to a mounting groove of the tool holder
is provided, and a work processing section to process
the work is provided, and on the shank part, an engagement
concave part that is engaged or disengaged freely from
a lock piece provided free to appear or disappear on
30 a wall of the mounting groove is provided, and on the
shank part, an engagement piece free to engage or
disengage with an engagement groove formed on the wall
of the mounting groove is provided free to appear or
disappear, and an insertion hole into which tool support
35 part for supporting the divided tool and also for
operating the appearance and disappearance of the

engagement piece is inserted freely is provided near the shank part.

5 9. A tool exchange device that exchanges a divided tool between the tool holder provided on the bending press and the exchange tool support that supports detachably a plurality of divided tools, characterized in that there are provided a hook support provided with an abut protrusion free to abut one of front and rear faces of the divided tool and a hook that is movable in the long direction of the hook support and has a curved tip that abuts freely to other face of the front and rear faces of the divided tool, and the front and the rear of the divided tool are pinched in between the abut protrusion and the tip of the hook.

20 10. The tool exchange device as described in Claim 9, characterized in that a hook support and a hook that are freely inserted into the insertion hole formed on the divided tool, the hook is arranged so that it may be moved freely in the direction crossing the long direction of the hook support and a part of the hook support is formed in form of a wedge so that when the hook support and the hook are inserted together into the insertion hole, they will engage with little play between the hook support and hook and the insertion hole.

30 11. The tool exchange device as described in claim 9 or 10, characterized in that at least either the abut protrusion or the tip provided on the hook in a curved shape acts as an operating section to operate the appearance and disappearance of the engagement piece provided on the divided tool free to project or retract.

35 12. A tool exchange mounting method for automatically carrying out the exchange of divided tool by using a

t ol exchange d vic b tw n th upper and low r tables
and the exchange upper tool support which supports a
plurality of divided upper tools free to attach or detach
and the exchange lower tool support which supports a
5 plurality of divided lower tools free to attach or detach,
in a press brake comprising an upper table provided with
an upper tool mounting part and a lower table provided
with a lower tool mounting part opposed to each other
upwards and downwards where either the upper table or
10 the lower table is made free to move up and down,
characterized in that when a plurality of tools are to
be mounted, a tool with the smallest tool breadths is
positioned between a plurality of divided tools.

15 13. A tool exchange mounting method described in claim
12, characterized by moving sideways a plurality of
divided tools adjacent to each other are to a tool mounting
section from the exchange tool support positioned on
the side of the tool holder and separating the divided
20 tools on the tool holder and arranging divided tools
with small widths in between the separated divided tools.

25 14. A divided tool exchange mounting method in press
brake, for mounting divided tools with desired lengths
onto the tool holder on upper table and lower table by
the tool exchange device while using divided tools
mounted on the tool holder and a plurality of divided
tools housed in the tool housing section, characterized
in that divided tools are selected which constitute the
30 tool station which has a total length corresponding to
the bending length in the product figure information,
the selected tool then displayed on the screen together
with the work, and the tools mounted after moving the
divided tools which interfere with the work to a
35 non-interf ring p sition.

15. A divided tool exchange mounting device in press
brake, for mounting divided tools with desired lengths
onto the tool holder on upper table and lower table by
the tool exchange device while using divided tools
5 mounted on the tool holder and a plurality of divided
tools housed in the tool housing section, characterized
in that it is provided with a tool selection means that
selects divided tools, which constitute the total length
10 of the tool station in correspondence to the bending
line length in the product figure information, from the
divided tools mounted on the tool holder and divided
tools housed in the tool housing section, an interference
detecting means, which detects interference between the
15 tool and work by displaying the tool station selected
by the tool selection means and the work on the screen
and a tool moving means to move the tool judged by the
interference detecting means to be interfering to a
non-interfering position.

16. A divided tool exchange device described in claim
15, wherein the tool selection means takes the quotient
of the total length of the tool station divided by the
length of the longest divided tool as the number of the
20 longest divided tools, and a combination of other divided
tools is arranged on the difference of the total length
25 and the total length of the longest divided tools.

17. A divided tool exchange device described in claim
15, wherein the tool selection means takes the quotient
30 of the total length of the metal station divided by the
length of longest divided tool as the number of the longest
divided tools but when a combination of other divided
tools cannot be arranged on the difference of the total
length and the total length of the longest divided tools,
35 on subtract d from the number is taken as the number
of the longest divided tools and a combination of other

tols is arranged on the difference of the total length and the total length of the longest divided tools.

18. A bending press system provided with a bending press (1) with at least one bending station to mount a plurality of divided tools and;

a tool housing device (65, 123) to house divided tools used in the bending press and;

a tool exchange device (61, 143) that moves the divided tools between the tool housing device and the bending station and mounts the divided tools on the bending station, comprising:

a first memory means (403) that stores the housing positions of each divided tool housed in the housing device and;

a second memory means (405) that stores the bending line length, flange length and the bending angle of the bent product;

a first computing means (407) to calculate the tool (cross section shape) type to be mounted on the bending station and the length of the bending station based on the bending line length, flange length, bending angle;

a second computing means (409) to calculate the arrangement of each divided tool on the bending station based on the tool type and length on the bending station; and

an NC control means (411) that controls the tool exchange device so that each divided tool is moved from the housing position of the housing device to the arranged position.

19. A system according to claim 18 wherein in determining the arrangement of divided tools, the second computing means gives priority to long divided tools.

20. A system according to claim 18, wherein in computing

the arrangement of divided tools on each station, computation is made so that the long divided tools are arranged on both ends and the short divided tools arranged in between.

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21. A system according to claim 18, wherein in the arrangement of the divided tools, reference is made to tool database that shows the divided tools housed in the tool housing device.

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22. A system according to claim 21, wherein the second computing means, after tentatively determining the divided tool arrangement, will check the data on tools housed in the tool housing device and will revise the tool arrangement if the divided tools are lacking.

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23. A system according to claim 22, wherein in case long divided tools are lacking, the second computing means will supplement the lack by short divided tools.

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24. A system according to claim 18, wherein the tool housing device includes a first housing section (65) located on the extension of the bending axis of the bending station and a second housing section (123) provided with tool support parts (129) for supporting a plurality of divided tools having the same cross-sectional shape type, and wherein the control device controls to house the divided tools of each same type in the second housing section, and subdivide the tools in the first housing section located at the tool insertion position to the bending station, and insert a designated number of designated divided tools all together into the bending station.

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25. A system according to claim 18, wherein the tool exchange device has a first tool exchange means to move

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freely each divided tool between the first housing section and the bending station, and a second tool exchange means to move freely a plurality of divided tools of the same cross-sectional shape type between the first housing section and the second housing section.

26. A method for mounting divided tools onto a bending station in a bending press system having a bending press (1) provided with at least one bending station to mount a plurality of divided tools and;

tool housing devices (123, 129) that house the divided tools used in the bending press and;

a tool exchange device (61, 143) that moves the divided tools between the tool housing device and the bending station and mounts the divided tools on the bending station, comprising:

a step to store the housed position of each divided tool housed in the housing device;

a step to determine, on basis of the length of the bending line and the length of flange and the bending angle of the bending part of the bent product, the tool (cross-sectional shape) type of the divided tool to be arranged on the bending station and the length of the bending station;

a step to determine the arrangement of each divided tool on basis of the tool type to be arranged on the bending station and the length of the bending station; and

a step to move each divided tool from the housed position in the housing device to the determined arrangement position.

27. The method according to claim 26, wherein priority is given to long divided tools in determining the arrangement of divided tools on the bending station.

28. The method according to claim 26, wher in th
divided tools on each station are arranged so that long
divided tools are arranged on both ends and the short
divided metals are arranged in between the long divided
5 tools.

29. The method according to claim 26, wherein when
determining the arrangement of said divided tools,
reference is made to the tool database which shows divided
10 tools housed in the tool housing device.

30. The method according to claim 29, wherein after
determining provisionally the arrangement of divided
tools, the data of tools housed in the tool housing device
15 is checked and if there is shortage of divided tools,
the tool arrangement will be rearranged.

31. The method according to claim 30, wherein if there
is shortage in the number of long tools, the shortage
20 will be supplemented by short divided tools.

32. The method according to claim 26, wherein the tool
housing device has a first housing section located on
the extension of the bending axis of the bending station
25 and a second housing section which is provided with
support member that supports a plurality of divided tools
of the same cross-sectional shape type, and the step
of moving includes step of housing tools of the same
type in the second housing section, and subdividing the
30 tools in the first housing section located at the tool
insertion position of the bending station and inserting
a designated number of designated divided tools into
the bending press altogether.

33. The method according to claim 26, wherein the tool
exchange device has a first tool exchange means that
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moves each divided tool freely between the first housing section and the bending station, and a first tool exchange means that moves a plurality of divided tools of the same cross-sectional shape type freely between the first housing section and the second housing section.

34. The method according to claim 26, wherein in the memorizing step, the mounting position of divided tools mounted on the bending station and the housing position of the divided tools housed in the tool magazine provided outside the bending press will also be stored.

35. The method according to claim 26, wherein at least either the number or the coordinate of the bending station may be determined on basis of the bending line length, flange length and the bending angle.

36. The method according to claim 26, wherein the order of bending of the bent product is determined on basis of the bending line length, flange length and the bending angle, and the length of each bending station and the tool (cross section shape) of the divided tools to be arranged on the bending station may be determined.

37. The system according to claim 18, wherein in the first memory means, the mount position of the divided tools mounted on the bending station, the housing position of the divided tools housed in the tool magazine outside the bending press may also be stored.

38. The system according to claim 18, wherein the first computation means will determine on basis of the bending line length, flange length, bending angle, at least either the number or the coordinate of the bending station.

39. The system according to claim 18, further comprising a means to determine the order of bending the bent product, based on the bending line length, flange length and bending angle and wherein the first
5 computation means will determine, by taking the bending order into consideration, the length of the bending station and tool (cross-sectional shape) type of the divided tools to be arranged on the bending station.

10 40. A method for manufacturing a plurality of bent products in a bending press system provided with:
a bending press that has at least one bending station to mount a plurality of divided tools and;
tool housing devices (123, 129) to house divided
15 tools for the bending press and;
tool exchange devices (61, 143) to move the divided tools between the tool housing devices and the bending station, comprising:
a step to store each divided tool on the bending
20 station and housed in the housing devices and housed in the tool magazine outside the bending press in the first memory means;
a step to determine the tool (cross section shape) type of the divided tools to be arranged on the bending
25 station and the length of the station on basis of the bending line length of the bent part, flange length and bending angle of the bent product;
a step to prepare data of an order of production in order to manufacture bent products that use tools
30 mounted on the bending stations or tools housed in the tool housing devices before manufacturing bent products that use tools housed in the tool magazine provided outside the bending press.

35 41. A method according to claim 40, wherein in preparing the order of production data, products that use identical

combination of tools are group d, and the order of production data is prepared so that bent products of the same product group may be processed successively.

- 5 42. A method according to claim 40, further comprising a step to determine the arrangement of each divided tool on the bending station, based on the tool type of the divided tools arranged on the bending station and a length of the bending station.

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